

♥Super Giant Heavy Duty High Speed Multi Engine Rocket Giant "2025v2.2

Bilingual Technical Parameter Comparison Table of Super Giant High-Speed Heavy-Lift Rocket Category Technical Item Chinese Parameter English Parameter

Power System	Number of Giant Main Engines	35 - 48 units	35 - 48 Units	Number of Spacecraft	Auxiliary Engines	14 - 18 units	14 - 18 Units	Power Type	1
Chemical Fuel Engine (Core Takeoff Power Source)	Chemical Fuel Engine (Core Takeoff Power Source)	Power Type 2	Nuclear Power System (Nuclear Battery + Nuclear Propulsion Engine)	Nuclear Power System (Nuclear Battery + Nuclear Propulsion Engine)	Power Type 3	Electric Engine (Cruise Phase Auxiliary Power)	Electric Engine (Cruise Phase Auxiliary Power)	Power Type 4	Solar Engine (Low-Earth & Deep Space Endurance Supplement)
Solar Engine (Low-Earth & Deep Space Endurance Supplement)	Engine Characteristics	Supports multi-engine combination switching	Supports Multi-engine Combination Switching	Key Performance	Takeoff Power	12,000 Tonnes	12,000 Tonnes	Payload Capacity	250 - 300 Tonnes
250 - 300 Tonnes	Maximum Range	1 - 1.5 Billion Kilometers	1 - 1.5 Billion Kilometers	Rocket Weight	8,500 - 9,000 Tonnes	8,500 - 9,000 Tonnes	Thrust and Specific Impulse	Chemical + nuclear hybrid mode, over 30% better than traditional heavy-lift rockets	Chemical + Nuclear Hybrid Mode, > 30% Better Than Traditional Heavy-Lift Rockets
Overall Dimensions	Height	125m / 138m	125m / 138m	Diameter	12.5m / 13.4m	12.5m / 13.4m	Total Number of Engines	50 Units / 60 Units	50 Units / 60 Units
Control & Integration	Driving Mode	Full Autopilot, Manual Driving, Semi-Autonomous Driving	Full Autopilot, Manual Driving, Semi-Autonomous Driving	System Features	Modular integration and interactive fusion, supporting real-time coordinated switching of multiple powers	Modular Integration & Interaction, Supports Real-Time Multi-Power Coordination	Support & Technology	Launch Facility	Super giant launch tower, load-bearing ≥ 15,000 Tonnes
Super Giant Launch Tower, Load-Bearing ≥ 15,000 Tonnes	Manufacturing Materials	Titanium alloy honeycomb composite material + carbon fiber reinforced ceramics (lightweight + high temperature and pressure resistance)	Titanium Alloy Honeycomb Composite + Carbon Fiber Reinforced Ceramics (Lightweight & High Temp/Pressure Resistant)	Drawing Requirements	30 - 50 sheets (schematic diagrams/installation diagrams/structural diagrams, etc.), labeled with extra-large black bold Chinese-English bilingual fonts	30 - 50 Sheets (Schematic/Installation/Structure Diagrams), Chinese-English Bilingual Extra-Large Black Bold Labels	Super Giant Rocket Engine	Super giant rocket engines (usually referring to engines with a thrust level of over 100 tons, such as 200-ton class or 500-ton class engines) are the core power of heavy-lift launch vehicles, and their design and application are of great significance in the aerospace field. The advantages and disadvantages are summarized as follows based on relevant information.	1. Advantages
1. High Thrust and Payload Capacity: Super giant engines can provide enormous takeoff thrust (e.g., 500-ton class solid rocket engines or 200-ton class liquid oxygen-methane engines), which directly enhances the rocket's payload capacity and enables heavy loads (such as deep-space probes or space station modules) to be sent into predetermined orbits.	2. Simplified Structure and Reliability: Taking solid rocket engines as an example, they have a relatively simple structure with fewer components, making it easy to achieve high thrust. Additionally, they are convenient to operate and maintain and can be stored for a long time, which helps reduce the overall system complexity of the rocket.	3. Cost-Effectiveness: The manufacturing cost of solid rocket engines is relatively low (about 1/10 to 1/20 of that of liquid rocket engines). Moreover, due to the stability of their propellants, they have good storage and safety performance, making them suitable for rapid-response missions.	4. Efficient Propellant Utilization: New-type						

liquid rocket engines (such as liquid oxygen-methane engines) have high specific impulse (a parameter measuring efficiency). Their combustion products are clean and not prone to coking, facilitating reuse and thereby reducing maintenance costs.⁵ Reusability: Some super giant liquid rocket engines (such as liquid oxygen-methane engines) support multiple ignitions and recovery, improving the economy and sustainability of the rocket.² Disadvantages¹. Difficulty in Thrust Adjustment: Once ignited, the thrust of solid rocket engines is difficult to adjust, and their operating time is short, which limits mission flexibility. Although the thrust of liquid rocket engines can be adjusted, their structure is complex, making it challenging to achieve high thrust.² Limitations in Specific Impulse and Efficiency: The specific impulse of solid rocket engines is usually low, resulting in lower propellant efficiency compared to liquid rocket engines. While liquid rocket engines have higher specific impulse, their complex systems may lead to energy loss.³ Technical Challenges and Reliability Risks: The design of super giant engines (such as 500-ton class solid rocket engines) needs to overcome problems related to materials and nozzle thermal management. For instance, throat liner components have to withstand extremely high temperatures and pressures, which may easily cause malfunctions. In addition, the parallel operation of multiple engines may lead to unstable work due to vibration coupling or control system issues.⁴ High Cost and Maintenance Complexity: Although solid rocket engines are low-cost, the development and maintenance costs of super giant liquid rocket engines (such as liquid oxygen-kerosene engines) are extremely high. Furthermore, they have poor long-term storage performance and require frequent inspections.⁵ Environmental Impact: The combustion of certain propellants (such as kerosene) may produce carbon deposits, increasing the cleaning workload after recovery. Although liquid oxygen-methane is clean, large-scale production still faces supply chain challenges. Supplementary NotesThe selection of super giant engines needs to balance mission requirements: solid rocket engines are suitable for providing initial high thrust (e.g., boosters), while liquid rocket engines are more suitable for core stage missions due to their adjustability and high efficiency. The future development direction will include new propellants like liquid oxygen-methane to enhance overall performance. [Raptor Rocket Engine](#) Developed by SpaceX, the Raptor Rocket Engine is a power system created for the Starship super heavy-lift launch vehicle, with its research and development commencing in 2016. It consists of a super heavy booster equipped with 33 engines and a Starship spacecraft fitted with 6 engines, featuring a fully reusable design. Its maximum payload capacity reaches 250 tons, and 150 tons when fully reusable. The engine adopts full-flow staged combustion cycle technology and uses liquid methane as fuel to avoid coking after combustion, facilitating rapid reuse. The third-generation Raptor engine entered mass production in August 2024, with its thrust increased from 185 tons (first generation) and 230 tons (second generation) to 280 tons. It successfully completed its first static fire test on August 9 of the same year. By adopting advanced metal 3D printing technology, the engine structure was simplified and its weight reduced to 1,525 kilograms. During the eighth test flight of the Starship on March 6, 2025, an "energy incident⁵, an "energy incident" occurred at the tail of the super heavy rocket, causing several engines to fail and ultimately leading to the disintegration of the second-stage spacecraft. List of Rocket Engines with High Thrust Worldwide The following is a ranking of rocket engines with high thrust globally, sorted from highest to lowest. It should be noted that data may vary across different sources, and the thrust value of an engine may differ depending on model iterations (e.g., sea-level thrust and vacuum thrust): 1. [RD-171MV](#) (Russia): Approximately 846 tons of thrust². RD-170 (Russia): Approximately 806 tons of thrust³. [F-1](#) (USA):

200 500
 1. 500
 200
 2.
 3.
 1/10~1/20
 4.
 5.
 1.
 2.
 3.
 500
 4.
 5.

SpaceX Raptor SpaceX “” 2016 33 6 250 150 1 8 2024 8 185 230 280 8 9 3D 1525 7 2025 3 6 “” 4 24 8 4 SpaceX 185 230 280 3 2024 8 9 SpaceX Raptor 3 McGregor 3 3 6 SpaceX 39 2025 3 6 SpaceX 4 ElonMusk@X 33 “” 6 “” 1 250 150 1 2025 3 6 “” “” “” “”

1. RD-171MV 846 2. RD-170 806 3. F-1 680.39 4. RD-180 423 5 5. RS-68A 320 4 6. BE-4 240 7. RS-25 240 8. Raptor 230 SpaceX V3 280 9. RS-24 213 10. RD-191 213 - 140

1. Starship 120 7590 100-150 SpaceX 2. 9 114 6100 150 3. N1 105 4620 95 4. 4400 140 2021 5. SLS 117 4173 95 6. 5 110.6 3408 140 7. 60 3540 100 8. 10 92 2678 70 9. 70 2300 64 SpaceX IV 10. IV 72 1850 28 2024

- + 10000 8 YF-480 500 3D SQX-9 7000 33 2030 - 76 1. 2025 - 1. SpaceX 10000 LEO 400 - 2. LEO 130 - 3. LEO 70 2. LEO 25 63.8 LEO

“” 3 “” 3C” 9.82 * “” 3 “” 3C” 9.7 * 4.2 * 5 * 5.2 * 2.25 “” 3” 9.82

118 吨级火箭 118 吨级火箭 5 吨级火箭 5 吨级火箭 5 吨 20 吨 60-70 吨级火箭
吨级火箭 118 吨级火箭 5 吨级火箭 5 吨级火箭 5 吨级火箭 5 吨级火箭
5 吨级火箭 5 吨级火箭 5 吨级火箭 63.8 吨级火箭 63.8 吨级火箭 63.8 吨级火箭
B 吨级火箭 22 吨级火箭 27 吨级火箭 5 吨级火箭 118 吨级火箭

“SpaceX”公司(Falcon Heavy)“SpaceX”公司(Falcon Heavy)5吨级火箭
SpaceX公司11“SpaceX”公司9吨级火箭“SpaceX”公司
63.8 吨级火箭 26.7 吨级火箭 16.8 吨级火箭 3.5 吨级火箭 4“SpaceX”公司 2019 年 6 月 25 日 24 吨级火箭 3 吨级火箭 1 吨级火箭 2023 年
10 月 13 日 10 月 19 日“SpaceX”公司“SpaceX”公司“SpaceX”公司24 吨级
“SpaceX”公司 Falcon Heavy5 吨级火箭 2018 年 2 月 6 日 2 吨级火箭 9 吨级火箭

“9 吨级火箭”Falcon HeavySpaceX 9 吨级火箭 9 吨级火箭 9 吨级火箭
9 吨级火箭 9 吨级火箭 LEO63.8 吨级火箭 737吨级- 吨级火箭
GTO26.7 吨级- 吨级火箭16.8 吨级- 吨级火箭3.5 吨级火箭 9 吨级火箭 吨级火箭- 吨级火箭70 吨级-
吨级火箭12.2 吨级- 吨级火箭1420 吨级火箭 9 吨级火箭 吨级火箭- 吨级火箭3 吨级 9 吨级火箭 27 吨级
吨级火箭 9 吨级- 吨级火箭 2280 吨级火箭 18 吨级 747吨级- 吨级火箭1 吨级火箭

吨级火箭 9 吨级火箭 TQ-12B吨级火箭 1 吨级火箭 TQ-15B吨级 - 吨级火箭 3 月 12 吨级火箭
吨级火箭 2 月 YF-77 吨级火箭 8 月 YF-100 吨级 - “SpaceX”公司 35 吨级
吨级火箭 6 吨级 41 吨级 - 吨级火箭 107 吨级火箭 500 吨级火箭 吨级火箭

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吨级火箭 吨级火箭(LEO)吨级火箭(TLI)吨级火箭 吨级火箭 吨级火箭
SpaceX 吨级(Super Heavy) 100-150 吨¹⁺ 100 吨⁺ (吨级) 7590 吨 120 吨 吨级火箭
吨级 49 SLS Block 1 95 吨 27 吨 4173 吨 98 吨 吨级火箭 8 吨级(Falcon Heavy) 63.8
吨 16.8 吨 2280 吨 70 吨 吨级火箭 38 吨 吨级(吨级) 140 吨⁺ 50 吨⁺ 5873 吨⁺ 108 吨 吨级
吨级(2035 吨级)28 吨级 B 25 吨 8.35 吨 1060 吨 53.7 吨 吨级火箭 12 吨级 吨级 A5
24.5 吨 - 980 吨 55.4 吨 吨级火箭 1 吨级(吨级) 100 吨 32 吨 4620 吨 60 吨 吨级火箭
吨级火箭 9 吨级 6 21.6 吨 - 860 吨 63 吨 吨级火箭 12 吨 LVM3 10 吨 4 吨 1100 吨
43.4 吨 吨级火箭¹吨级 LEO 吨级火箭 150 吨级火箭 100-120 吨⁺吨级火箭
吨级火箭 吨级火箭 1. 吨级 • 吨级33 吨级火箭 • 吨级火箭
吨级\$300-400/吨级 9 吨 1/3 • 吨级2023 吨级火箭 2. 吨级 • 吨级
480 吨级火箭(YF-130) + 220 吨级

<https://baike.baidu.com/item/%E6%B6%B2%E6%B0%A2/9471112>吨级火箭(YF-90)

• 吨级火箭 2030 吨级火箭 2035 年 3. 吨级火箭 • 吨级火箭 LEO 118 吨
1967-1973 吨级火箭 • N1 吨级火箭 LEO 95 吨 4 吨级火箭 4. 吨级火箭 • 吨级
SpaceX 吨级 90%吨级火箭2023 年 9 吨级 87 吨 • 吨级火箭 80%
吨级火箭 • 吨级火箭 SLS吨级火箭 • 吨级火箭 B吨级火箭
吨级 A5 • 吨级火箭 6吨级火箭 LVM3吨级火箭 H3 吨级火箭 吨级火箭
吨级火箭 ±10%吨级

吨级火箭“吨级/吨级”吨级火箭 ≥50 t 吨级火箭 LEO 吨级火箭
2024-2025 吨级火箭“吨级火箭”
吨级火箭 ---吨级火箭 吨级 LEO 吨级火箭/吨级火箭
吨级火箭/吨级火箭 吨级 LEO 吨级 t GTO 吨级 t 吨级 kN 吨级/吨级 吨级 吨级 × m 吨级/吨级 1
SpaceX 吨级 Starship (吨级) 吨级/吨级 150(吨级)250(吨级) 100 ≈5000 ≈74 000 (33×Raptor

2) 2/ロケット CH4+LOX 122×9 2024 ロケット[^1][^5] 2 ロケット CZ-9 (ロ) ロ 140 ≈50
 4140 ≈58 000 (ロ 4×CZ-5 ロ) 3/ロケット+ロ ロ+LOX / H2+LOX 93×10 ロ 2030 ロ
 [^1][^2] 2 ロケット Saturn V (ロ) ロ 140 48.6 2970 34 000 (5×F-1) 3/ロケット+ロ ロ
 +LOX / H2+LOX 110.6×10.1 1967-1973ロ13/13 ロ[^1][^2] 4 ロケット Yenisei (ロ) ロ
 ロ 130 ≈49 3 100 ≈40 000 (ロ 12×RD-171+2×RD-180) 3/ロケット+ロ ロ 113×8.6 ロ
 2028 ロケットロケット[^1][^2] 4 SLS Block 2 (ロ) ロ 130 45+ 2 948 41 700 (2×5-seg
 SRB+4×RS-25) 2/ロ+ロ PBAN+H2+LOX 117×8.4 2022 ロ Block 1ロBlock 2 ロ
 2028[^1][^2] 6 ロケット Energia (ロ) ロ 100 34 2 400 46 000 (4×RD-0120+4×RD-
 170) 2/ロケット+ロ ロ+LOX / H2+LOX 60×8 1987-1988ロ2/2 ロ[^1][^2] 7 N1-L3 (ロ)
 ロ 95 — 2 735 45 400 (30×NK-15) 5/ロケット ロ+LOX 105×17 1969-1972ロ4 ロケット
 [^1][^2] 8 ロケット Falcon Heavy (ロ) ロ 63.8 26.7 1 420 22 800 (3×9×Merlin 1D)
 2+ロ/ロケット RP-1+LOX 70×3.66 2018 ロケットロケット[^1][^2] 9 ロケット New Glenn (ロ) ロ
 45 13 1 500 17 100 (7×BE-4) 2/ロケット CH4+LOX 82×7 ロケット 2025[^1][^2] ---ロ
 ロケットロケット 1. ロケットStarship - ロケット 6×RaptorロケットLEO ロ 150 tロケット 250 t
 ロ v3 ロ 400 t[^5]ロ - ロケット ≈1.5ロケット+ロケットロケット 2. ロケット - ロ 10 m ロ
 ロ2023 ロケット“ロケット+ロ”ロケットロケット“ロケット+ロ”ロケットロケット 5 800 tロケットロケット
 ≥50 t[^1]ロ - ロケット 2035 ロケット“ロケット”ロケットロケット 3. ロケット - ロケットロケットロケット
 F-1 ロケットロケット 6.77 MNロケットロケットロケット 4. SLS ロ - Block 1 LEO 70 tロBlock 2 ロ
 ロ+ロケットロケット 130 tロRS-25 ロケット 366 sロ 452 sロ 5. ロ/ロ - ロ 2020-2030 ロ
 ロケットロケットロケットロケット“ロ”ロケット 12×RD-171MV+2×RD-180+1×RD-0124ロケット
 ロ 40 MNロ 6. ロ - ロケット“ロケット”ロケット46 MNロケットロケット“ロ”ロケットロケット 7.
 N1-L3 - ロ 30 ロ NK-15 ロケットロケットロケットロケット 1976 ロケット 8. ロケット - ロケット“ロ
 ロ”ロケット27 ロ Merlin 1D+ ロケットロケットロケットロケット 9. ロ - BE-4 ロケットロケット
 2.4 MNロケット 100 ロケットロケットロケット BE-3U ロ ---ロ/ロ“ロケット 50 t”ロケットロケット
 ロ/ロ LEO t ロ ロ B ロ 25 ロケットロケット 5 ECA ロ 21 2023 ロ ロ A5 ロ 24
 2020 ロケットロケット H-IIB ロ 19 2020 ロ Delta IV Heavy ロ 28.8 2024 ロ LVM3 ロ
 10 ロ“ロ”ロ ロ ロ 13.5 ロ ---ロ - ロ“ロ≥50 t+ ロケットロケット”ロケットロケット
 ロケットロケットロケット 100 t ロケットロケットロケットロケット 50 t ロケット - ロケットロケットロケット 63.8
 tロ100 t ロケットロケット/ロケットロCKETCZ-9ロSLS Block 2ロケット - ロケット 150-250 t ロ
 ロケットロケットロケット 1 ロケットロケット“ロ”ロケットロケット/kg ロ ロケットロケットロケットロケット
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 ロケットロケット2025 ロ** ロケットロケットロケットロケットロケットロケット| **ロ/ロ
 ** | **ロ** | **ロ** | **ロ** | **ロ** | **ロ** | **ロ** | **ロ**
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 |-----|-----|-----|-----|-----
 |-----|-----|-----|-----|-----
 |-----|-----|-----|-----|| **ロ** | Starship
 | 2024 ロ | 7590 | 250 | 100 | 9 | 120 | ロ | 33 ロRaptorV3 | ロ |
 ロ | **ロ** | ロCZ-9 | 2030 ロ | 5873 | 150 | 50 | 10 | 110 | ロ
 /ロ | 4 ロ YF-135ロ+28 ロ YF-230 | ロ | ロ | **ロ** |
 Yenisei | 2030 ロ | 4400 | 103 | 35 | 8 | 98 | ロ | 6 ロ RD-171MVロ | ロ
 | **ロ** | ロSLS | 2022 ロ | 3991 | 95 | 27 | 8.4 | 98 | ロ
 /ロ | 4 ロ RS-25+2 ロ | ロ | ロ | **ロ** | ロ 64Ariane 64 |
 2023 ロ | 1350 | 21.6 | 11.5 | 5.4 | 63 | ロ/ロ | 1 ロ Vulcain 2.1+4 ロ | ロ
 | **ロ** | ロLVM3 | 2023 ロ | 1050 | 10 | 4 | 4 | 43.5
 | ロ/ロ | 2 ロ Vikas+6 ロ | ロ | ロ | **ロ** | ロNew
 Glenn | 2026 ロ | 2500 | 45 | 13 | 7 | 98 | ロ | 7 ロ BE-4 | ロ
 || **ロ** | ロ BロCZ-5B | 2020 ロ | 1078 | 25 | - | 5 | 53.7 | ロ/ロ | 2 ロ YF-
 77+8 ロ YF-100 | ロ | ロ | **ロ** | ロ A5Angara A5 | 2014 ロ | 885 |
 24.5 | 7.5 | 3.6 | 55 | ロ | 1 ロ RD-191ロ+4 ロ | ロ | ロ | **ロ
 ** | ロ-CVega-C | 2022 ロ | 426 | 2.3 | 1.2 | 3 | 35.5 | ロ/ロ | 3 ロ+1
 AVUM+ | ロ | ロ | **ロ** | ロ-3 ロ | 2015 ロ | 200 | 0.5 | 0.2 |
 1.5 | 24 | ロ | ロ | ロ | --- **ロ** ## # **1. ロ
 Starshipロ** - **ロ** 33 ロ V3 ロロ 230

300bar 40% - ** +1 700 SLS 1/28 - ** 2024 ##
 # **2. ** - ** 450 330 10 - ** “ ” 1000 0.1% - ** ## **3. ** - ** N1 30 6 RD-171MV 800 60% - ** RD-180 12% ### **4. ** - ** LVM3 “ ” 10 65% - ** -3 0.5 2000 --- ** | ** | ** | ** | **
 ** | ** 64**

||-----|-----|-----|-----|-----||
 / | 2.8 | 5.3 | 12.6 | 18.5 || | 7 | 14 | 30 | 21 || | 1:180 | 1:150 | 1:120 | 1:100 || | 95% | 98% | 82% | 75% |
 “ ” ≥ 50 t LEO 2024-2025 “ ” --- LEO / () t GTO t kN / m 1 SpaceX Starship () / 150() 250() 100 $\approx 5000 \approx 74\,000$ (33×Raptor 2) 2/ CH4+LOX 122×9 2024 [^1][^5] 2 CZ-9 () 140 $\approx 50\,4140 \approx 58\,000$ (4×CZ-5) 3/ + +LOX / H2+LOX 93×10 2030 [^1][^2] 2 Saturn V () 140 48.6 2970 34 000 (5×F-1) 3/ + +LOX / H2+LOX 110.6×10.1 1967-1973 13/13 [^1][^2] 4 Yenisei () 130 $\approx 49\,3\,100 \approx 40\,000$ (12×RD-171+2×RD-180) 3/ + + 113×8.6 2028 [^1][^2] 4 SLS Block 2 () 130 45+ 2 948 41 700 (2×5-seg SRB+4×RS-25) 2/ + PBAN+H2+LOX 117×8.4 2022 Block 1 Block 2 2028 [^1][^2] 6 Energia () 100 34 2 400 46 000 (4×RD-0120+4×RD-170) 2/ + +LOX / H2+LOX 60×8 1987-1988 2/2 [^1][^2] 7 N1-L3 () 95 — 2 735 45 400 (30×NK-15) 5/ +LOX 105×17 1969-1972 4 [^1][^2] 8 Falcon Heavy () 63.8 26.7 1 420 22 800 (3×9×Merlin 1D) 2+ / RP-1+LOX 70×3.66 2018 [^1][^2] 9 New Glenn () 45 13 1 500 17 100 (7×BE-4) 2/ CH4+LOX 82×7 2025 [^1][^2] --- 1. Starship - 6×Raptor LEO 150 t 250 t v3 400 t [^5] - ≈ 1.5 + 2. - 10 m 2023 “ + ” “ + ” 5 800 t ≥ 50 t [^1] - 2035 “ ” 3. - F-1 6.77 MN 4. SLS - Block 1 LEO 70 t Block 2 + 130 t RS-25 366 s 452 s 5. / - 2020-2030 “ ” 12×RD-171MV+2×RD-180+1×RD-0124 40 MN 6. - “ ” “ ” 46 MN “ ” 7. N1-L3 - 30 NK-15 1976 8. - “ ” 27 Merlin 1D+ 9. - BE-4 2.4 MN 100 BE-3U --- “ ” 50 t / LEO t B 25 5 ECA 21 2023 A5 24 2020 H-IIIB 19 2020 Delta IV Heavy 28.8 2024 LVM3 10 “ ” 13.5 --- - “ ≥ 50 t + ” 100 t 50 t - 63.8 t 100 t / CZ-9 SLS Block 2 - 150-250 t 1 “ ” /kg 1. F F * 58.4 * 3.35 * 480 * 8.6 200 350 * 2. * 4 * 5 * 3.35 * 56.97

“” F/A-22 “” SpaceX
F/A-22 “” F/A-22 “”
 * * 14,365 * 27,216 *
 1.7 9,150 * 1.58 * 15,240 *
 9.0g * 1,200 * 2 F119-PW-100 *
 155 * AN/APG-77 *
 * 3 3 AIM-9 6 AIM-120C 2 AIM-120C
 2 GBU-32 * 4 BLU-109B
 AGM-88 “” * 29°
 SpaceX Raptor SpaceX
 Starship 2 Raptor 2 *
 230 2,250 kN * * 1.3 3.1 *
 3 Raptor 3 * 280 *
 350 * 1,525 * 3D 2
 21% 7% Starship * 120 * 9 29
 * 5,000-7,500 * 100 *
 33 * 6 3 3 “”
 F/A-22 “”

Category	Technical Item	Chinese
Parameter	English Parameter	Power System
35~48	35~48 Units	14~18
14~18	14~18 Units	1
Chemical Fuel Engine (Core Takeoff Power Source)	2	2
Nuclear Power System (Nuclear Battery + Nuclear Propulsion Engine)	3	3
Electric Engine (Cruise Phase Auxiliary Power)	4	4
Solar Engine (Low-Earth & Deep Space Endurance Supplement)		
Supports Multi-engine Combination Switching		
Key Performance		
12000	12,000 Tonnes	250~300
250~300	250~300 Tonnes	10~15
1~1.5 Billion Kilometers	8500~9000	8,500~9,000 Tonnes
30%	Chemical + Nuclear Hybrid Mode, >30% Better Than	
Traditional Heavy-Lift Rockets	Overall Dimensions	125 / 138
125	125m / 138m	12.5 / 13.4
12.5	12.5m / 13.4m	50 / 60
50	50 Units / 60 Units	
Control & Integration	Full Autopilot, Manual Driving, Semi-Autonomous Driving	
Modular Integration & Interaction, Supports Real-Time Multi-Power Coordination		
Support & Technology		
≥15000	Super Giant Launch Tower, Load-Bearing ≥15,000 Tonnes	
Titanium Alloy Honeycomb Composite + Carbon Fiber Reinforced Ceramics (Lightweight & High Temp/Pressure Resistant)		
(Schematic/Installation/Structure Diagrams)		

●SpaceX
--- **Starship** ### **1. Raptor**
** - ** - ** - **
363 /380 15% -
300bar Space Shuttle 206bar 185 V3 **230**
180:1 - ** - ** 96%
Sabatier - ** - **20,000 /**
10,000G CMSX-4 + - 33 **
“pogo oscillation” ### **2. - *
** - **4 12m²“”**10
** Falcon 9 3 - **”**Mechazilla
8 **1 ** - ** - **“”**
60°TPS**2200°C** - **“”
“”2G** ### **3. -
** - ** - **304L **2219-T87 90%\$2/kg vs
\$20/kg 205MPa 30% - **“”
15%**±6g** - **TPS** - **
20,000+ 5-10cm <10 - **
**Regenerative Cooling
10MW/m² ### **4. - ** - **Linux
IMUGPS**0.1m/s **10 - **
“” 50ms - ** - **
10 /45 1200 3 - **
10,000 Space Shuttle 1/220 **1/1000
**5. - ** - **1000m³
916m³ Starlink V2 mini 100 / - **MDA
7 **80 - ** - **100
O₂ 90% 95% 3 - **4 8
1.5 **30°** --- ** | ** | TRL
| 2030 | ||-----|-----|-----|
|-----|| V3 | TRL 8 | TRL 9 |
100 || | TRL 7 | TRL 9 100 | 0.1%/ ||
| TRL 6 | TRL 8 |

Starship Program's Five Disruptive Key Technologies

- 1. Raptor Engine: Full-Flow Staged Combustion Revolution** - Technical breakthroughs:-
World's first practical full-flow staged combustion cycle engine, with both oxidizer and fuel turbopumps driven by gas generators- Specific impulse reaches 363s (sea level)/380s (vacuum), 15% higher than traditional open-cycle engines- Combustion chamber pressure exceeds 300 bar (vs 206 bar for Space Shuttle main engines)- Thrust increased from 185 tons (Gen 1) to 230 tons (V3), thrust-to-weight ratio of 180:1- LOX/methane propellant combination: clean combustion solves reuse maintenance issues; methane can be produced on Mars via Sabatier reaction- Engineering challenges:- Turbopump speed exceeds 20,000 rpm, blades withstand 10,000G forces- 33-engine thrust vectoring control with millisecond-level adjustments
- 2. Fully Reusable Architecture: Cost Revolution** -
Booster recovery:- Grid fin aerodynamic control: four titanium fins (12m² area)

achieve 10-meter landing accuracy- "Chopsticks" mechanical arm capture: saves ~8 tons by eliminating landing legs- Starship vehicle recovery:- "Belly flop" reentry: 60° angle of attack, TPS withstands 2200°C- "Hop" landing trajectory: reduces impact to 2G 3. Stainless Steel Airframe: Counter-intuitive Innovation - Material revolution:- 304L stainless steel instead of aluminum alloy, 90% cost reduction (\$2/kg vs \$20/kg)- Corrugated structure: 15% weight reduction, withstands $\pm 6g$ loads- Thermal protection system:- Tile-based TPS: 20,000+ SiC ceramic tiles, replaceable in <10 minutes- Methane film cooling: handles 10MW/m² heat flux 4. Autonomous Control & Software-Defined Rocket - Flight control software:- Linux RTOS navigation system with 0.1m/s velocity accuracy- Fault self-repair: 50ms engine reconfiguration capability- Ground operations:- Rapid propellant loading: 10 tons/second, 45 minutes for 1200 tons- Digital twin simulation: 10,000 Monte Carlo runs, launch risk reduced to 1/1000 5. Multi-mission Modular Design - Cargo variant:- 1000m³ cargo volume, can carry 100 Starlink V2 mini-satellites- 80-ton capacity robotic arm for on-orbit assembly- Crew variant:- Capacity for 100 astronauts, 3-month deep space endurance- Lunar landing variant: 4 redundant engines, 8m legs, 30° slope capability Technology Readiness & Future Challenges Technology Area Current TRL 2030 Target Main Bottleneck Raptor V3 Engine TRL 8 TRL 9 Turbopump blade fatigue life (target 100 cycles) Full Reusability TRL 7 TRL 9 Heat shield tile loss rate (current 0.1%) Orbital Capability TRL 6 TRL 8 Upper stage engine vacuum ignition success rate □

● 1. Zhang Zhi, Rong Yi, Qin Yao, et al. "Development Status of the Vulcain 2 Engine", AIAA-2002-3840. 2. Caisso P, Brossel P, Souchier A, et al. "Development Status of the Vulcain 2 Engine", AIAA-2002-3840. 3. Byrd T. "The J-2X Upper Stage Engine: From Design to Hardware", AIAA-2010-6968. 4. Tenden S. "Composite Cased Solid Propulsion Rocket Motor for Hyper Velocity Missile Demonstration Program", AIAA-2007-7795. 5. Betti F, Perugini P, Mataloni A, et al. "Design and Development of VEGA Solid Rocket Motors Composite Cases", AIAA-2007-7962. 1. 2019年9月9日“Space Shuttle Main Engine: The First Twenty Years and Beyond” SSME POGO“Improvement Plan” H-II RD-0120“VK-KT-2017-03”“CN111876500A” ≥ 7

2. CN110934783A “ π 型变幅杆” 8-12 m 变幅杆-变幅杆
变幅杆变幅杆3. US20200156789A1 “Multi-Engine Launch Vehicle Active
Damping System” SpaceX 变幅杆变幅杆变幅杆变幅杆变幅杆变幅杆 POGO变幅杆变幅杆4.
US20190367271A1 “Large Payload Fairing and Core Stage Interstage for Heavy-
Lift Vehicle” NASA SLS Block-2 变幅杆变幅杆-变幅杆变幅杆-变幅杆变幅杆变幅杆
>100 kW/m²5. EP3285073B1 “Method for Igniting a Cluster of Liquid Rocket
Engines at High Altitude” ArianeGroup 变幅杆变幅杆变幅杆变幅杆变幅杆变幅杆变幅杆
变幅杆变幅杆变幅杆变幅杆1. 变幅杆/变幅杆 - NASA NTRS (<https://ntrs.nasa.gov>) 变幅杆 AIAA 变幅杆
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